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ABSTRACT

Science education has often struggled to determine effective teaching methodologies and learning strategies. One promising field of research has been that of alternative frameworks. The research described in this paper describes how immersion in an unfamiliar environment and culture affected teacher learning, some of the significant experiences which affected teachers functioning in the dual role of learner and teacher, and how the combination of these elements changed the teachers' images of themselves and their values. Included are: a description of the project entitled "Tropical Rainforest Experience" involving a trip to Costa Rica for teachers (as novice learners), six sections which discuss various learning experiences, and a discussion of the implications of these learning experiences. (CW)

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LEARNING: A MULTIFARIOUS EXPERIENCE

Paper presented at
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LEARNING: A MULTIFARIOUS EXPERIENCE

"Education is an initiation into worthwhile experiences."
from Education as initiation
by Richard S. Peters

Introduction - A Metaphor

Initiations are not a new phenomena. Rites of passage have been performed throughout time. In general they have signified entrance into a new and more responsible role in life through various quests and rituals.

All of us also have experienced an initiation of some kind during our lives. Perhaps it was a special ceremony for entrance into a club or organization, or a party celebrating a milestone in our lives such as adulthood or marriage. In any event, these rites of passage signal that a significant achievement has been accomplished and that the future will be different from the past because of this achievement.

This paper describes the initiation which twenty teachers experienced during a trip to a Costa Rican rain forest. This initiation took the form of not only experiencing a different environment and culture, but also, for many of the participants, a significant journey in personal growth.

Introduction - Science Education

In the last few decades science education research has struggled to determine effective teaching methodologies and learning strategies. One of the promising fields of research has been that of alternative frameworks. A tremendous amount of research already has been done in discovering learners' preconceptions and misconceptions. For a compilation of this research refer to Driver and Erickson (1983), Gilbert and Watts (1983) or Osborne and Freyberg (1985). However, even this school of research has been faced with difficult challenges such as the tenacity of preconceptions and the influence of culture and language on conceptual understanding. See Viega, Pereira and Maskill (1989), Viennot (1979) or Duit (1981) for some examples.

Some recent research has attempted to explore these other factors in both formal and informal learning settings. For example Shapiro (1989) explored how the students' orientation or approach to science guided their conceptual learning in the classroom. Klein (1982) looked at how the differences in the mother tongue affected science learning in school children from the same socio-economic background. Perry (1989) examined the cognitive and affective aspects of visitors (both children and adults) of a science exhibit at a museum.

Other research has focused on teacher thinking. This field of research has been approached by both the phenomenolog/symbolic interaction camp (how teachers construct their thinking) and the critical theorist camp (how teachers' thinking can be changed). Pope (1989) gives an overview of the progress of this research. Hence, there is a very diverse and rich body of knowedge which addresses how students learn science and how teachers think about teaching science.

The research as described in this paper is three-fold: 1) it describes how emersion in an unfamiliar environment and culture affected teacher learning, both cognitive and affective; 2) it describes some of the significant experiences which affected teachers funtioning in the dual role of learner and teacher; and 3) it describes how the combination of these elements changed the teachers' images of themselves and their values.

The paper does not attempt to be comprehensive nor to assign values to these factors. However, it does try to elucidate how these factors had an impact upon individuals in particular experiences and the significance of these factors on learning.

The uniqueness of this project is important, not because it included a trip to a foreign country, but because it studied experienced teachers placed in the role of novice learners. Their reflections on how they experienced the trip from a learner's standpoint are particularly noteworthy.

This paper is organized as follows. First of all it describes the project " Tropical Rain Forest Experience" and how it originated. This is followed by six sections which discuss various learning experiences. The final section discusses the implications of these learning experiences.

A Tropical Rain Forest Experience

The Indianapolis Zoo and IUPUI (Indiana University-Purdue University-Indianapolis) have been involved in cooperative learning ventures for a number of years. They have jointly

sponsored workshops for teachers for the last six years. In addition, graduate science education classes from IUPUI have frequently visited the zoo and developed learning projects around zoo experiences.

In the winter of 1988, Giovanna Holbrook of the Holbrook Travel Agency, Gainesville, Florida, contacted the zoo about developing a trip program to Costa Rica to educate teachers about the tropical rain forest. Although the zoo had a tropical rain forest exhibit and provided workshops on the tropical rain forest for teachers, it had not been involved in a trip experience before. The idea of a trip experience took on greater impetus as the news media increased its coverage about the problems being encountered with the rapid devastation of the tropical rain forest. In December 1988 Michael Cohen from IUPUI and David Fishel and Bill Christie from the zoo made a five day preliminary excursion to a tropical rain forest in Costa Rica to investigate the feasibility of jointly sponsoring a trip for teachers to the rain forest.

The following spring a grant proposal was sent to the Indiana Commission for Higher Education requesting funding for a nine day trip to Costa Rica for twenty teachers from Indiana. The trip and its preparation coincided with the Smithsonian traveling "Tropical Rain Forest" exhibit at the Indiana State Museum in Indianapolis the following winter. The grant was approved, but with the stipulation that the teachers would have to pay one-half of their travel costs which amounted to about $700. The trip organizers were Dr. Michael R. Cohen, director, and Linda Furuness, coordinator, from IUPUI and David Fishel, a science educator with the zoo. Linda Furuness also served as a participant observer for the program with the charge of following the teachers in their conceptual development about the tropical rain forest.

Flyers about the program were disseminated in August and the applications received reviewed during September. The teachers chosen had a wide diversity of backgrounds and experiences. Of the twenty teachers chosen, seven were elementary, six were junior high/middle school and seven were high school teachers. Their teaching experience ranged from one semester to over twenty years. Eight of the teachers lived outside the metropolitan area of Indianapolis, one of whom had a three-hour drive one way to Indianapolis.

The subject matter which the teachers taught included biology, physical science, earth science, and environmental science. A number of them were in the process of setting up outdoor laboratories in their respective schools. Some of the teachers had gifted and talented pupils while others taught at-risk kids.

In addition, the teachers had a wide variety of other skills and talents which greatly enhanced the diversity of the group. One of the teachers had been a professional geologist, one had been a professional photographer, two were fluent in Spanish, one had done research on brown bats in Indiana, two were amateur herpetologists. Two of them had been actively involved in curriculum development professionally, and one member of the group was the president of the state Environmental Education Association. They were certainly representative of the kind of environment into which they were going to enter!

The tropical rain forest program itself included ten workshops, five prior to the trip to prepare the teachers for what they were going to experience, and five after the trip to develop curriculum materials about the rain forest. In addition, three graduate degree credits were granted at a nominal fee.

The workshops began the first Saturday in November. The first workshop coincided with the opening of the traveling Smithsonian exhibition "Tropical Rain Forest" that was visiting Indianapolis November 1989 through January 1990. The teachers were able to attend the special preview of the exhibit at which one of our participants gave the keynote presentation.

Other pre-experience workshops that were held at the zoo included speakers from Indiana University who provided information about the geology, evolution, botany, and sociology of neotropical rain forests. All of these speakers had visited the rain forests of Central or South America at some time. In addition, one afternoon was spent in phototaking instruction, and another day was set aside for designing activities and sharing information gathering techniques to be used in the rain forest.

The trip had a departure date of the day after Christmas and lasted nine days in all. Two days were spent flying to and from Costa Rica. Four days were spent at Selva Verde Lodge in northeastern Costa Rica where a hilly frontier area contains sections of rain forest bordering on cleared areas. (Selva Verde Lodge is located just outside the small village of Chilamate along the Sarapiqui River.)

On day five the group traveled to Volcan Arenal, an active volcano in northwestern Costa Rica. Arrangements had been made to stay overnight (New Year's Eve) at the Arenal Observatory which was about 1.5 miles (2 km) from the volcano's summit. The following day was spent exploring Arenal and traveling back to the capital city of San Jose. The last day was spent in San Jose.

In addition to the above itinerary, a number of excursions were planned or presented themselves once the group was in Costa Rica. Side trips were made to Braulio Carrillo (a cloud forest), a banana plantation, and down the Sarapiqui River. While in San Jose, the group visited the University of Costa Rica, a herpetology research center, and the new Center for Biodiversity.

The experiences during the project were documented using observations collected from journal entries by the participant observer, written comments and evaluations by the participants, as well as numerous discussions with the teachers themselves. It would be impossible to relate all of what transpired on this trip, but the following sections describe some of the significant learning experiences which occurred and hopefully reveal the spirit of the encounter.

Squish and Foggy Lenses

One of the major pretrip discussions centered around what kind of footwear to take. The teachers knew that the undergrowth would be quite wet but were unsure about the muddiness of the ground. Should they buy rubber boots or hiking boots? Rubber boots were generally not owned by most of the participants and would mean an additional purchase. And, additional expenses were growing as teachers applied for passports, received inoculations, purchased appropriate clothing, hats, and film and camera filters, etcetera. In addition, if the teachers were going to be doing a lot of hiking, they would need comfortable footwear, and rubber boots in a hot climate would definitely not be comfortable.

Whatever had been expected, it was not what was experienced. It rained for a short time each day in the rain forest. Since the soil was very clayey, these conditions produced lots of mud--far more than had ever been anticipated. Walking in four inches of very squishy mud and sliding down slippery hillsides was a new sensory experience for most of the participants, and one that made a lasting impression.

As residents of a modern midwestern society, boots generally are only worn for warmth in the wintertime. When it rains, one leaps over mud puddles or avoids the squishy grass and mud by walking on the sidewalk. To have no alternative but to walk straight through the middle of a muddy path and to do so for hours was a very new sensory experience and it greatly affected the perceptions that were being made about the rain forest.

Another sensory perception about which the teachers became keenly aware was the humidity. Humidity is not something new to Hoosiers. Indiana can be quite hot in the summertime, and when it is, the humidity is also very high. Being out of doors during these periods of time is quite uncomfortable so that most people living in Indiana tend to avoid going outside, but stay in their air conditioned or at least fan cooled offices, homes, and cars. Frequently this kind of weather is very oppressive.

During the time the teachers were in the rain forest, the weather was quite pleasant--perhaps cooler than normal because of peripheral effects from a very cold weather front which had been affecting North America. The temperature in the forest was generally around 75° to 80°F with a humidity of 99% or greater. It was warm enough to perspire profusely, but not so hot, particularly under the shade of the canopy, that it was oppressive. The hilltops were relatively comfortable, especially when occasional breezes would blow through them.

But, the humidity did affect their lenses, both spectacle and camera. It was often hard to know which needed to be wiped--glasses or the camera lens; frequently it was both. By the time both lenses were wiped dry, the first one wiped was fogged over again. This proved to be quite a dilemma when trying to focus on a spectacular flower or leaf or especially an insect. This kind of humidity was definitely different from what most of the teachers had ever felt before. And, it became a very real part of their understanding of the rain forest. Further, it was a learning perception which could not be understood by reading or viewing slides or hearing about second-hand.

These are only two examples of the sensory perceptions which played an important role in learning about the rain forest. The teachers also mentioned the earthy smell of the forest itself, the smell of the skunk cabbage, the sound of the swollen Sarapiqui River, the rushing of waterfalls down steep slopes, and the sound of strange bird calls such as hummingbirds and toucans. During this experience learning was dependent upon these sensory inputs and trying to make sense of them.

Orion On Its Side And Butterflies That Go Click

The first night in the rain forest proved to be an amazing one. The group had just finished supper, and since the sun sets about six o'clock, it was very dark outside. Because Chilamate is quite some distance from any city, the night sky was black. Novelists often describe the night sky as black velvet, and looking up at it, one could understand why it

received that poetic description. A number of the persons in the group who were interested in astronomy were quite familiar with the northern constellations. One of the prominent ones that can be seen in Indiana is Orion. The constellation Orion consists of three major stars which form a "belt" and three smaller stars which are close together and are about 60° to the "belt."

On this first night as the group left the dining hall, the astronomers in the group were very excited about seeing Orion. But, there was something wrong with "him": he was laying on his side, not standing up as he does in Hoosier skies. Their excitement was contagious even for those who could not grasp the significance of their discovery. They looked in awe at the bright stars and planets as the "experts" pointed out familiar as well as new celestial bodies.

This was not the only counter-intuitive experience which some members of the group had. Near the rain forest was some hilly pastureland. This place was a favorite spot for some of the teachers to go to observe different kinds of birds and butterflies. On one of the last days of the stay at Selva Verde, two of the teachers came back from spending the day in the pastureland with barely concealed excitement about something which they had observed. They wanted to keep their observation a secret until the whole group was together because it was something which they said was truly unbelievable.

When the group had gathered that evening, the two teachers told about seeing some unusual, beautiful blue butterflies. But, at the same time they heard clicking noises. They kept trying to identify where the clicking noises were coming from since there were no other birds or insects in the vacinity. Finally, they had to conclude that, fantastic as it might seem, the clicking noises were being made by the butterflies! Who had ever heard butterflies that clicked? Another teacher volunteered that these teachers were not imagining the phenomenon since he had read somewhere about it. For those two teachers, it still remains a counter-intuitive experience. It is amazing to them, even after witnessing it first hand, that this phenomenon could be so.

Accepting these kinds of learning experiences was hard to do. Even though the experience itself may have been real enough, it was still difficult to believe because it countradicted all of the teachers' previous perceptions about the world. And, because of this disequilibrium in perception, the teachers considered it an important learning experience.

Bullet Ants and the White Cattle Companions

The pre-trip workshops helped to prepare the teachers for what they might see on the trip. In addition to listening to experts on the tropical rain forest, the teachers were required to read two books: A Neotropical Companion by John C. Kricher and The Naturalist in Nicaragua by Thomas Belt. Both of these books describe in great detail the flora and fauna of the area into which the teachers were going. And, the participants were anticipating seeing at least some of these animals and plants. Each day they spent in the rain forest, the teachers became more and more overwhelmed with the immense variety of species which they encountered.

The first evening at the lodge the teachers gathered to discuss some of their early experiences. One of the teachers who taught a summer program in nature and environmental education for kids and was very knowledgeable about the trees and animals in an Indiana woods, shared with the group that walking through a forested area and not knowing the names of all of the species was rather disconcerting for him. The experience reminded him of what his students must be feeling the first time that he takes them out into the woods. This comment evoked a discussion concerning the importance of knowing the names of plants and animals. A number of the teachers felt that it was important for their students to be able to name what they saw. Others said that being able to observe and record observations was more important than being able to name everything.

This dilemma had become obvious even during the preparation for the trip. One of the leaders who had been involved in the preliminary excursion had described a particular kind of ant that he had observed which was very large (about 2.5 cm long) and had a particularly painful bite. He could not remember the exact name of this species of ant, but it sounded something like "bullet ant"--at least its bite would probably feel like a bullet wound! So the name "bullet ant" stuck with the insect. The group saw many representatives of this particular critter on their hikes and were careful to avoid them. They all called them "bullet ants." It was only later that they discovered that the real name was "bola ant." However, whenever the group talks about this particular insect, they still refer to it as the "bullet ant" even though they know that this is not its scientific name.

Two days after the group's discussion about knowing the names of species, a situation occurred which reinforced the naming problem. Two of the teachers had gone with a local interpreter to visit in the home of a tico family. (The Costa Ricans call themselves ticos.) The two teachers had learned a

great deal about the tico culture and social structure from this experience. On their walk back the interpreter was telling them about the medicinal herbs which ticos rely on for healing of almost every ailment. He was pointing out the different species of plant along the roadside, naming them, and telling what particular ailment was remedied by each plant.

Because our culture does not rely on herbal remedies, not only were the plants unfamiliar, but the remedies as well, were difficult to relate to the teachers' own experiences. One of the teachers remarked that she could now understand the discussion of a few nights earlier because it was impossible to remember all of the plants which their interpreter had been talking about. To her they did not make sense.

One plant which he showed her that did make sense however, was the cocoa plant. She was thrilled to see the cocoa fruit and be able to taste the seed from which comes our favorite flavor. With this plant she could identify. How important were the other herbs to her? Not very. Could she remember their names? No.

Since the purpose of naming species of plants and animals is to be able to communicate with other people, the group knew that they would have to be able to identify what they were seeing in some way. Frequently the teachers identified different species by picking out a few words which described their most notable features. For example, they would refer to the "butterflies with transparent wings," the "white cattle campanion birds," or the "scarlet tananger in reverse." Not only did this kind of naming enable them to share what they had seen, but it also provided a description for possible identification once they had returned to the lodge where a small library was available.

A number of the teachers would pour over the books in the library trying to identify, with varying degrees of success, what they had seen. For them, being able to know a species' name was important, for others just having seen a different kind of species was satisfying.

The high school teachers in particular struggled greatly with the naming problem. Their experience in the rain forest had been one in which they could communicate quite effectively without naming species, but when they returned home, they would be expected to require their students to do the opposite--know the names of things. They knew what was required of them as high school science teachers and would comply.

Jose, Jesus, and the Children of Chilamate

One of the most influential and yet unexpected learning experiences of the trip was the affect of interpersonal relationships on the participants. These included the close friendships which were developed among the participants who were "living in each other's pockets" for nine straight days, as well as the relationships which were made with a number of ticos whom they had the privilege to meet.

One of the persons who really affected the group was Jose. In his early twenties, he was one of twelve brothers and sisters who lived in a small house near Selva Verde. Jose's father worked for the OTS (Organization for Tropical Studies) station in nearby Peurto Viejo. Jose served as translator and guide for the group for two days. He was always clean and neatly dressed and was well educated having attended university for a year before dropping out because of lack of funds. Jose eagerly shared information not only about the rain forest and its history in the area, but also about the people who lived there. He was very patient in answering the group's questions and even guided them in through the back gate" of a banana plantation where they were able to see the growing banana plants as well as the waste disposal problems involved in their production.

Although the teachers only talked with Jose for a few days, they did not consider him to be a "poor, deprived Latin American" even though his living standards certainly were less than those to which the group was accustomed. But Jose came to be understood as a warm, caring human being who was an eager learner. A number of the teachers developed a close friendship with him and continued to communicate with him even after the trip was over.

Another person whom the teachers got to know was the bus driver, Jesus. When Jesus picked the group up at the airport in San Jose, he spoke no English. During the two and one-half hour drive to Selva Verde, two of the teachers who were fluent in Spanish struck up a conversation with him and asked him about his family and his work. Many of the teachers were eager to learn not only about the rain forest ecology, but also about the people themselves who live with the rain forest.

Jesus endeared himself to the group by successfully steering the bus through a number of disconcerting situations. The trek to Braulio Carrillo National Park had to be made for the most part on a gravel road. This in itself was frequently slow going. However, the perilous part was crossing over two rivers on wooden bridges with no side rails. These bridges were constructed of planks about the

width of a bus tire. One of the rivers ran through a narrow gorge at the point of crossing. The crossing was particularly unnerving on the way back to the lodge in the dark.

The second part of the trip involved a visit to an active volcano called Arenal. Traveling to Volcan Arenal was an interesting experience by itself. Since ticos do not believe in road signs in the rural areas, it was necessary to stop at each town the bus passed through to ask directions. And of course, depending upon whom one would ask, one would get a different set of directions. In addition, the final road to the Arenal Observatory at which the group was to stay was unique by American standards. Since the streams coming down from the surrounding area were not large, bridges were not built to cross them. It had just recently rained and the streams which had to be forded were quite swift. But, Jesus navigated them successfully.

These were only a few of the shared experiences which endeared the group to Jesus. By the end of their time together, all of the teachers had learned a few Spanish phrases and Jesus had learned a few English phrases. Jesus was treated as if he were one of the group, not just the "bus driver." On the last night together, the teachers gave him a pair of boots and a pair of binoculars which he had admired. For some it was a tearful departure.

One other interaction between the ticos and the teachers is important to relate. On the last night in Selva Verde the teachers had an opportunity to meet some of the families who lived in Chilamate. In addition to parents, a grandmother, and the village priest, there were about twenty school children present. The children were quite shy and spoke no English. Most of the teachers spoke negligible Spanish. The children opened the get-together by singing a couple of native songs. Introductions along with translations were made.

It was then the teachers' turn to sing. A few of the less restrained teachers with elementary experience began by singing such notorious songs as "Michael Row Your Boat Ashore." The children watched with shy smiles as the teachers "made fools of themselves." The teachers then each picked out a child and demonstrated the "Hokey Pokey"! The children began to giggle and laugh, the parents were smiling and clapping. Hand games and songs followed the "Hokey Pokey." The teachers showed the children ones they knew, and the children showed the teachers ones they knew. These were interspersed with a popcorn treat and lots of laughter. Hugs were deemed to be in order before the group parted and bright shining eyes were apparent on both the children as well as the teachers.

During the course of the evening, some of the teachers had an opportunity to talk to some of the parents. One of the fathers talked about how he used to go into the forest, shoot perhaps thirty birds in one day, and think nothing about it. Now he stated that he realized how important it was to conserve what they had and not to waste it. It was disturbing for a number of teachers to realize that someone who had so little by American standards should be more concerned about conservation than were many Americans.

For many of the teachers, the interaction with the Costa Rican people was the most significant learning experience that occurred. It was more than learning about the ticos or learning from them. It was a shared, even an emotional, kind of learning which enabled the participants to understand the human aspect of the rain forest problem. The people directly interacting with the rain forest were no longer just faces in pictures or names on a page, but warm, caring friends who were living simple self-sustaining lives.

This even inspired some of the teachers to action. It was learned that the town of Chilamate is in need of a library where not only books could be kept, but other kinds of learning materials as well. Because of the remoteness of the area and the large number of children who needed to be educated, learning materials were scarce. Those materials that were available often increased or decreased in number with changes in teaching assignments in the district. Since returning home from the trip, a number of the teachers are planning projects to help build a library and to keep in touch with the children of Chilamate.

Although the teachers' initial goal had been to learn as much as they could about the tropical rain forest, the most significant experiences which they had involved their interaction with other people. Their concept of the forest as a result seems not to center on the flora and fauna, although these are am important part, but on the relationship of the ticos with their environment.

Alto, Alto And Other Touristy Actions

Each of the participants was very excited about going on the trip. The tension of anticipation in the group could be felt each time they met for the pre-trip workshops. They expressed it verbally numerous times in the three-minute writes they did during these workshops. The airline pilot did not need to worry about getting the plane off the ground--the group was already high in the air with excitement when they boarded the plane.

They were eager learners and as such had a great deal of self-confidence in spite of venturing into unfamiliar terrain on foreign soil and lacking Spanish-speaking skills. This sense of adventure influenced their actions in ways that at times surprised even them. Looking and acting like tourists did not bother them!

At the first opportunity at Selva Verde the teachers headed for the forest. They had to walk about a quarter of a mile along a road and cross a pasture in order to reach the rain forest. The road was lined with tall trees and small wooden houses which they observed as they walked along. The accuity of one teacher's eyes brought them all to a halt. High up in one of the trees was a sloth. Those walking ahead stopped; those walking behind quickly caught up. The group was bunched up on the side of the road all looking up into a tree through binoculars and cameras and talking excitedly. Cars, bicycles, and trucks passed by, the occupants of which were all gawking at the teachers gawking at a sloth! The young children from a house across the road came out to watch the teachers too.

In Indiana, under ordinary circumstances, these teachers admitted they would not have been so bold, so obvious. In Costa Rica they were free to be silly and adventurous. They seemed to have little thought of what others would think of their actions. The self-reservation was eclipsed by something new and exciting.

This attitude of adventure and self-confidence pervaded throughout the trip. Traveling in the bus always took twice as long as was expected, not only because of the bad roads, but also because of the numerous stops which were made along the way. The bus would drive by a waterfall or an area that had been recently logged and the shout of "alto! alto!" would issue forth. Jesus would stop the bus, the teachers would all troop off, snap pictures, and discuss what they were seeing. Fifteen minutes later, they would climb back on the bus and Jesus would drive off.

This happened most frequently during the trip to Volcan Arenal. The area around the volcano is quite flat so that the group was able to first spot Arenal from about ten miles away. About ten minutes after first observing its peak one of the teachers noticed that a cloud of white steam was spouting from it. It had erupted! "Alto! Alto!" and off the bus the teachers scrambled. They stood in front of the bus and along the side of the road snapping pictures of the first volcano they had ever seen erupt. Cars, trucks, and buses passed by, their drivers and passengers staring at them. The teachers barely noticed the attention, so excited were they at the sighting of the eruption. Fifteen minutes later they were

back on the bus heading towards Arenal. Seventeen minutes later the volcano erupted again. "Alto! Alto!" Again, the bus stopped, again the group trooped off, snapping pictures, and talking excitedly while other vehicles passed by. When the eruption was over the group climbed back on the bus again and continued their travel toward the journey's end.

The volcano continued to erupt every fifteen to forty-five minutes. And, every time the group persuaded Jesus to stop the bus so that they could look at the volcano. Their attitude toward learning--experiencing something new--was so overwhelming that it overcame any inhibitions and reserve they had about themselves. Teachers do not readily make fools of themselves, and yet here they were willing to be considered at least peculiar for the sake of learning something new. Had they been less sure of themselves, less willing to be adventurous, less willing to be different, they would certainly not have learned nearly as much as they did.

Understanding As A Complex Phenomenon

During the pre-trip workshops the teachers had studied the complexity of the rain forest biome. They knew that there were a tremendous number of species that existed in the rain forest, some of which had not yet been discovered. They knew that the species in the rain forest were constantly evolving. They knew that the depressed economies of the rain forest countries and the overpopulation problems were the major causes of deforestation. They knew too that the U.S.'s demand for rain forest products was a part of the devastation as well.

Most of the persons in the group went to the rain forest to try to find some answers as to why these things were happening and what could be done to stop the destruction. They also knew at the same time, that it was probably impossible to stop the destruction of the rain forests. They hoped that perhaps by seeing a rain forest first hand, they would be able to find out why it was really happening, and then share that understanding with their students.

The teachers came away from the experience with some of their questions answered. They saw the immense diversity and beauty of the rain forest. They saw the ticos making simple livings on their cleared land. They saw people desirous of keeping their natural resources, but at the same time wanting a better life style--maybe something that approaches that of the Americans! They met caring families and delightful children who lived uncomplicated lives in harmony with the rain forest. What the teachers found were no simple answers, not even complex answers.

In most class studies, teachers and students are concerned about finding the right answers or drawing conclusions about what has been studied. And, our own lives, by and large, are based on drawing conclusions and finding right answers. This process did not happen for those who participated in the experience. There were questions and concerns about which insights were gained. The teachers understood the diversity and the deforestation problem much better after having observed it. But, few of them would be willing to draw conclusions about what they found. The amazing aspect of this is that they feel comfortable not being able to do that. Drawing definitive conclusions about what they had learned seemed really quite impossible, and unimportant. Sharing the insights and values which they had gained seemed of much greater worth.

Discussion

The above descriptions of the teachers' experiences are based on the constructivist philosophy of learning. This philosophy has evolved from George Kelly's Personal Construct Theory (1955). Pines and West (1986) describe the current understanding of this theory in the following way:

> learning and the growth of understanding always involves a learner constructing his or her own private understanding of some part of the public knowledge. Constructionists are interested in situations in which students are attempting to make sense of relatively large bodies of conceptual knowledge or using the knowledge that they have internalized to generate explanations of their experiences in the world.

This was very apparent in the way the teachers responded to their new environment. Not only did they struggle to make sense of the counter-intuitive experiences that they had such as observing the constellation Orion in a unique position or hearing butterflies making sounds, but also connecting their new sensory perceptions such as high humidity and deep mud with their previous sensory perceptions. Their motives for visiting the rain forest centered around understanding the environmental problems pertaining to the rain forest, itself. They wanted to observe first-hand and make their own evaluations of the growing concern for the rain forest's devastation. Hence, not only did the organizers have a constructivist approach, but the teachers as well, were approaching the project with a constructivist perspective.

In attempting to determine the significant factors affecting the experience and relating them to present learning theories and models, a number of problems became

apparent. Although there are a number of models for learning science in formal settings and for learning science in informal settings, there are none for learning science in trip or field settings. In addition, the learning theories which have been developed are primarily from the learner perspective. Two examples of these follow.

In a recent research project, Bonnie Shapiro (1989) identified a number of views and beliefs which influence learning in the classroom.

> "The case studies show how anticipations and expectations of the science classroom guide individual thought and action during science learning. Changes in one's ideas about natural phenomena and about science learning requires the consideration and acceptance of new expectations and anticipations of many interweaving factors...There appear to be varied and often highly personal conditions necessary in order for some students to regard the ideas presented to them as valid."

By observing individual student learning styles and interactions with others, as well as attitudes toward learning, she developed the following model. Shapiro's model focuses not only on the learner's perception of knowledge and learning, but also on interpersonal relationships, and the learner's view of education and his own self-worth.

Some of these same factors were influential in learning which occurred for the group on the trip. For example, some of the most important learning experiences were those involving interaction with others such as Jose and the children of Chilamate. Many of the teachers cannot talk about the rain forest without mentioning these individuals. The teachers also discovered that experiences were an important part of learning. It was also obvious from their attitude and actions on the trip that their own enhanced self-confidence aided their learning..

Malone and Lepper (1987) have devised a taxonomy for looking at motivation for learning in informal settings. Their factors include challenge, curiosity, control, fantasy, cooperation, competition, and recognition. Many of these factors were present in the trip experience. The trip proved to be not only a mental and emotional challenge to understand the ecology and sociology of a tropical rain forest, but also a physical challenge. Much of the hiking was strenuous and the climate was not amenable to a great deal of exertion. The observation of unique flora and fauna such as the sloth and the butterflies and the eruption of an active volcano certainly were sources of curiosity for the teachers.

Cooperation within the group was also an essential element. The teachers were required to explore in groups of at least two or more persons. This meant that they had to work together, perhaps in helping each other through the mud, or holding equipment while one person exposed a speciment for examination or photography.

Although the participants in the rain forest experience were not children nor initiates into the science endeavor, nevertheless, they were neophites in experiencing and understanding the tropical rain forest and the culture of the people interacting with it. The species of plants and animals were new; the physical environment was new; the climate was different from what they had previously experienced; the orientation of the sun, moon, and stars was peculiar; the people they met had vastly different living standards, values, and world views from their own. In this respect they were learners. But, at the same time, they were also teachers and this entailed a very different orientation from that of learner.

It was natural to assume that the members of the group would think about their role as teachers on the trip. The purpose of the experience was in part to enable them to develop curriculum materials about the tropical rain forest for their students. On the trip the teachers seemed to move back and forth between the learning perspective and the teaching perspective. All of them knew how to be learners and teachers in the formal school setting. A few of them knew how to be a teacher in the informal setting. Becoming a learner in the informal setting was strikingly unfamiliar for most of the teachers. This moving back and forth between the teacher perspective and the learner perspective seemed to give a much greater depth of understanding.

This dichotomy of being learner and at the same time teacher seemed to be very significant. For example, upon first hiking into the rain forest, one of the teachers stated, "It was like walking into a woods for the first time--awesome!" Frequently the participants would go into the rain forest in larger groups than two or three. One high school teacher who had spent the day with two elementary teachers, one junior high teacher, and one other high school teacher remarked that it was amazing that all five of them could be observing the same bug or leaf and talk about how they would use it differently for each of their unique situations. Learning about the same phenomenon, but understanding it from five different teaching perspectives proved to be very thought-provoking for this teacher.

As a result of these experiences, a number of the teachers have reevaluated how they were teaching in their classroom and

made a commitment to change their teaching methodologies. Others are re-examining their own personal values and priorities. What they learned in experiencing a different environment and culture seemed to have had a strong impact upon their views of themselves as individuals as well as teachers.

It is important also to note that during this experience the teachers saw themselves as being successful and fulfilled. Their expectations for the trip were far exceeded. This also points out the importance which personal thoughts and feelings have on the learning process. The following thoughts which were provided by one of the teachers after returning home from the experience sum up well the tropical rain forest experience.

> Each person must build their understanding of the world and discover their place in it for themselves. Interactions with others are essential--interactions with people who have experience in searching, experiencing and truly knowing. Making learning alive for the students is to engage them in real learning, not just learning what others have experienced or thought. Only after they have the experience of creating their own knowledge base and believing in themselves, can they question their thinking, change it, and grow.

The approach used in this paper expands on much that has been done previously. In this paper I have tried to concentrate not just on the content and thinking skills which were employed by the participants, but the complex relationship of sensory, psychomotor, intuitive, and emotional factors as well. Not only did this combination of factors facilitate learning, it also empowered the participants and led them to action. Are not these the goals of environmental education also?

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